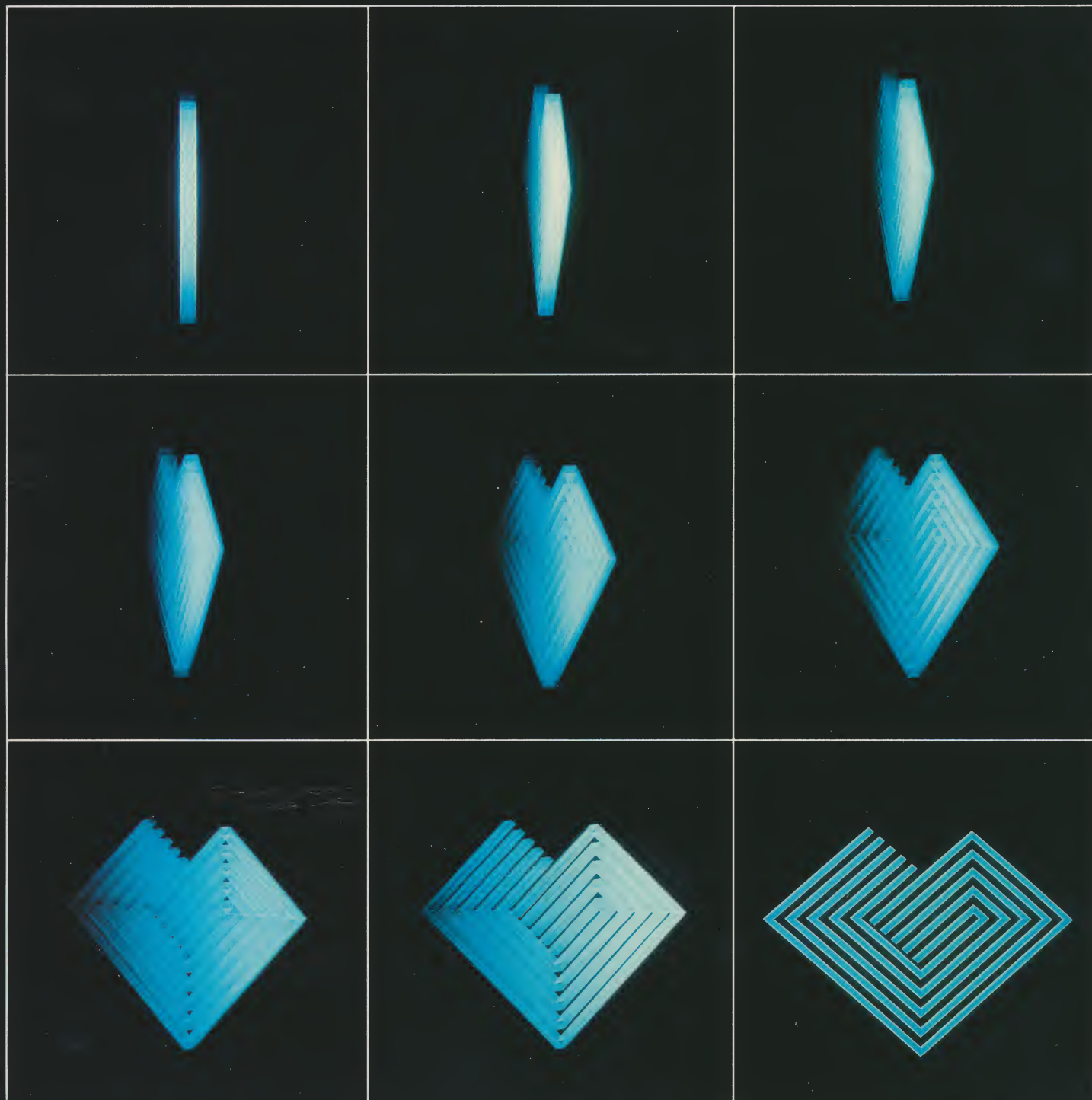




Vector General

VG 33000

The mind's eye



Distributed Processing Architecture

Over the past decade, a great deal of investment has been made in improving the performance of specific calligraphic display hardware modules (e.g. vector generators, font generators, and transformation generators). Very little attention, however, has been given to systems considerations, i.e., improving the overall responsiveness of a display support system, consisting not only of display hardware but also including an interface, host computer operating system, display driver, and graphics display library.

As a result, many calligraphic systems can display high information content but exhibit poor update timing (the rate at which displayed information can be changed) due to graphics library overhead, task switching latency, and interrupt response times. Today's time-shared environment, where tasks are queued up for execution and user programs are swapped out to disk, exacerbates the architectural limitations of current technology calligraphic displays where every light pen hit must be processed by the host computer.

The new VG 33000 Distributed Graphics Processing System is a significant architectural departure from the currently prevalent directly-coupled calligraphic

display generator. It represents an important functional upgrade while utilizing VG modules of proven reliability. Without sacrificing the transformation and vector generation speeds of the high bandwidth strokewriting subsystem, the VG 33000 enhances systems characteristics to off-load the host computer and improve interactive response time through distributing the picture processing functions.

The new VG 33000 Distributed Graphics Processing System is an evolutionary step along the path of defining computational functions which are strictly graphical in nature (viewporting, nesting of transformations, etc.) and isolating and compartmentalizing those functions in the display unit, as opposed to consuming host computer resources to perform them.

What the intelligent terminal is to the alphanumeric display, the VG 33000 is to the calligraphic display. To provide the operator with powerful local editing and viewing facilities, general purpose computational and communications capabilities have been incorporated and the graphics software package has been structured to execute most functions in the display unit.

That's why the VG 33000 is the perfect choice for such diverse application areas as CAD/CAM, simulation, Command/Communications/Control (C³), data analysis, and 3D modeling.

Software and Firmware

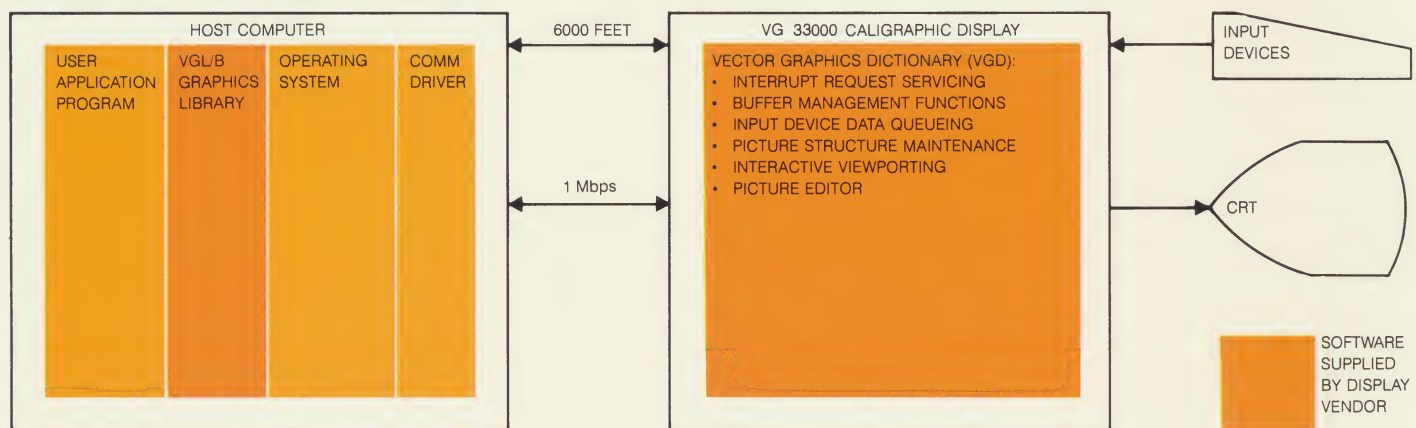
A comprehensive software package is provided for VG 33000 users, allowing the easy creation of specialized application programs without requiring detailed knowledge of internal hardware functions. The division of labor between the host computer and the display unit is determined by the package structure which provides FORTRAN entry points to the Vector Graphics Library (VGL/B) on the host and relegates most of the graphics processing to the Vector Graphics Dictionary (VGD) in the VG 33000.

Vector Graphics Library (VGL/B).

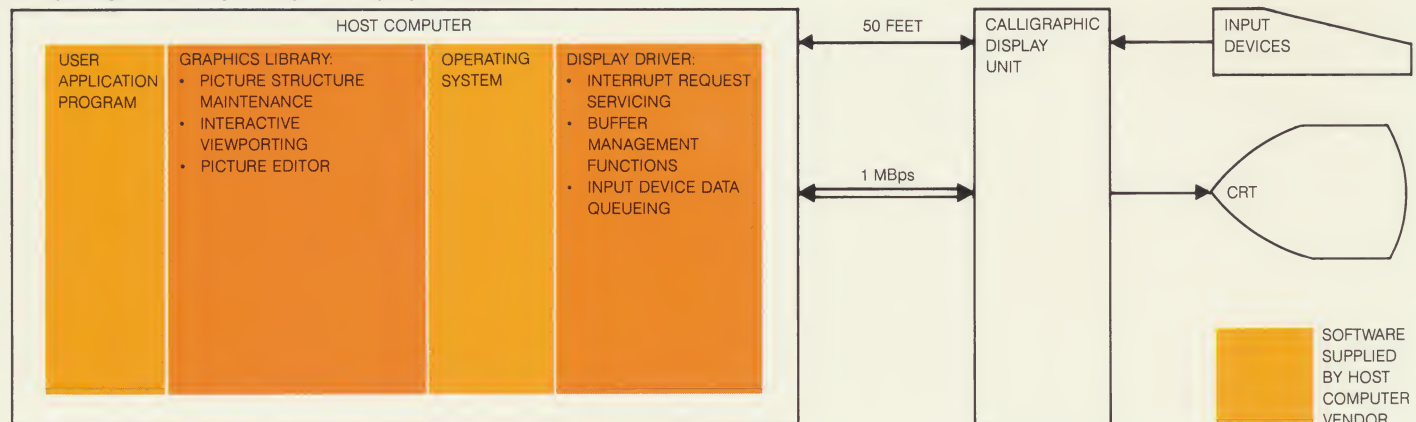
VGL/B is a small, FORTRAN-callable library, with entry points to define a 2-dimensional or 3-dimensional hierarchically-organized, structured display file in terms of graphics primitives, objects, and instances of objects. Primitives (such as absolute vectors, relative vectors, character strings, etc.) are translated into a generic command format and packaged with untransformed data for batched or unbatched transmission to the VG 33000.

Data input is specified in floating-point world coordinates. Static transformation of homogeneous coordinate data is supported by a complete set of matrix manipulation and transformation routines.

VG 33000 Distributed Display Architecture



Competing Directly-Coupled Display Architecture



Vector Graphics Dictionary (VGD).

VGD is a dictionary of graphical and support functions which is PROM-resident in the VG 33000. VGD incorporates routines which translate generic graphical commands and untransformed data into display format for refresh on the CRT. Dynamic transformations are fully supported and adjustable parameter routines allow linkage of mapped input data to picture variables.

VGD performs all buffer management functions and maintenance of picture tables (including linkage of object instances), servicing of interrupt requests, interactive device data queueing, matrix compositions, interactive viewporting, in-line arithmetic computations, and picture editing.

Through the use of other PROM-resident routines, it is able to support communication with the host computer (using industry-standard line protocols), with alphanumeric terminals, and with other VG 33000's.

Finally, a powerful picture debugging feature is available which allows the programmer, through an alphanumeric terminal attached to the VG 33000, to access the same graphical facilities that are available with VGL/B, to interrogate and change attributes or data in a running display.

Communications

VG 33000 stations can be truly distributed where they are needed without compromising performance on even the most exacting high-bandwidth display problems.

The VG 33000 Distributed Graphics Processing System incorporates as standard hardware a synchronous serial port with integral modem which operates at 1 Mbps in half-duplex mode over 6000 feet (1829 m) of coaxial cable, or at 56 Kbps over 18000 feet (5487 m). The port can be interfaced to the Digital Equipment Corporation (DEC) DMC-11 or DMR-11 network link line unit modules and supports features of the DIGITAL Data Communications Message Protocol (DDCMP). Thus high speed communication is possible with any VAX-11 or PDP-11 computer utilizing DEC-supported communications gear.

Standard equipment also includes two asynchronous serial ports with modem control and programmable baud generation from 50 bps to 19.2 Kbps. These ports can be configured with RS-232 or RS-423 drivers and receivers and can support low-speed communications with a host computer, alphanumeric terminal, Off-line Diagnostic Unit (ODU), or other VG 33000, anywhere telephone lines are found.

Hardware

The VG 33000 offers a wide choice of display capabilities and physical configurations. Features include a full range of input devices including alphanumeric keyboard, data tablet, joystick, lighted function switches, control dials, light pen, display monitors (monochrome and color) in a range of sizes and speeds, and modular work station furniture.

Other features of the VG 33000 are: 256 programmable intensity levels; absolute, relative, incremental, or autoincremental vectors; and hardware blinking of displayed elements under program control.

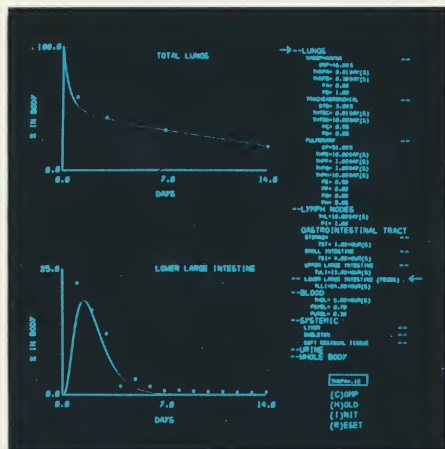
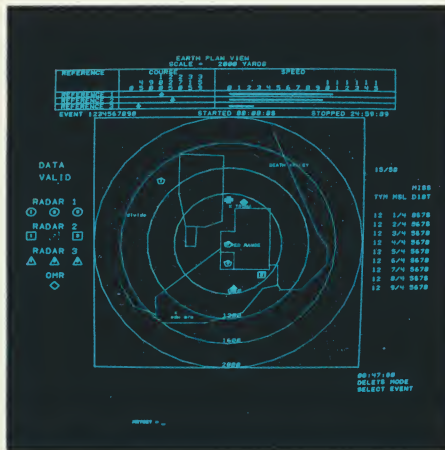
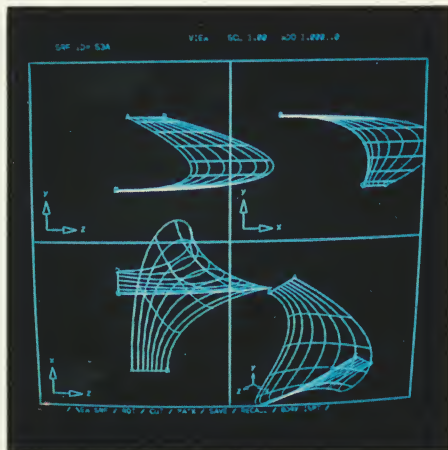
Hardware facilities include features such as character generation, a variety of line textures, a circle arc generator, scaling, clip, zoom, translation, rotation, and depth cueing.

The system designer has complete freedom in selecting the exact configuration and features initially suited to the user's needs; and the VG 33000 can be field upgraded with additional capabilities without extensive modification to the controller. The user can start with one version and complement of options, and upgrade with additional monitors, devices, and features, even expanding from 2D to 3D after his graphics display is installed.

Two models of the VG 33000 are currently offered:

VG 33002. A 2-dimensional (including single-axis rotation) in-line transformation and display generator, the VG 33002 DGU consists of a Display Processor Unit (DPU); a microprocessor-based Display I/O Control Unit (IOC); 2-dimensional Digital Transformation Unit (DTU); X-Y Vector Generator Unit (VGU); 4-channel Monitor Control Unit (MCU); and a 20-slot, rack-mounted Electronic Card Chassis and Power Supply (DCR2).

VG 33003. A high speed, 3-dimensional, parallel transformation and display generator, the VG 33003 DGU consists of a Display Processor Unit (DPU); a microprocessor-based Display I/O Unit (IOC); an overlapped 3-dimensional Digital Transformation Unit (DTU); X-Y-Z Vector Generator Unit (VGU) which provides depth cueing; 4-channel Monitor Control Unit (MCU); and a single 20-slot rack-mounted Electronic Card Chassis and Power Supply (DCR2). The VG 33003 allows mixing of ultra high-speed non-transformed vectors with 3-dimensional information.



Display Processor Unit (DPU). The DPU gives the VG 33000 its intelligence and general purpose processing capability. At the heart of the unit lies a 2 MIPS 16-bit HMOS Processor with (17) 32-bit registers, a 32-bit program counter, 16-bit status register, 14 addressing modes, 56 instruction types, and 16/32-bit arithmetic capability. The processor accesses program storage, refresh memory, and device registers via a 22-bit Address Map (AM). The DPU can be configured with 32-128 Kbytes of dynamic RAM and 32-128 Kbytes of non-volatile memory.

A Direct Memory Access (DMA) controller permits single-cycle transfers between the synchronous serial port and program storage or refresh memory. The on-board bus supports digital data rates up to 4 Mbytes/sec. A 16-bit parallel port is standard equipment for interfacing to external devices such as printer/plotters, raster displays, or host computers.

The DPU incorporates a discrete bipolar multiplier which generates a 16-bit product in 1 microsec and a 32-bit product in 2 microsecs. A time of day clock is derived from a programmable timer which also features two interval timers with rates of 800 KHz. Subsequent to power-on, a firmware "upness test" automatically executes, assuring the correct operation of major subsystems in the DPU.

Refresh Buffer Memory (RBM). This module is a high-speed 16-bit dual-ported RAM memory expandable in 32 Kbyte increments to 256 Kbytes, with a cycle time of 800 nsecs.

Display I/O Controller (IOC). The IOC interacts between the DPU and the graphics generators, processing display list instruction and data interrupts, as well as programmed inputs and outputs between the computer and display.

Digital Transformation Unit (DTU).

This hardware module performs scaling, translation, and rotation transformations on 2D and 3D coordinate endpoint data in less than 1.6 microsecs. Simultaneously, post-translation and picture scaling (from unity to negative unity) are performed in the X-Y plane of the screen. In addition, the DTU has two sets of registers which allow toggling between transformations without reestablishing the values.

Circle Arc Generator (CAG). A hardware option available on all VG 33000 Distributed Graphics Processing Systems, the CAG utilizes a digital technique that provides high quality circle/circular arc synthesis in two and three dimensions. Besides circles, the CAG can generate ellipses, polygons, 2D ruled quadrilat-

eral surfaces (for generation of grids and shading), and 3D ruled patches (for 3D surfaces). All geometric shapes thus generated are fully transformable.

Clip-Zoom Unit (CZU). The Clip-Zoom Unit (CZU) presents a magnified view of a VG 33000 picture, placed and clipped in a specified rectangular viewport on the display screen. The Clip-Zoom Unit takes the 3D vectors transformed by the DTU and processes them to generate new vectors for output to the Vector Generator Unit.

Vector Generator Unit (VGU). In addition to supplying the analog drive signals to the CRT's, the VGU can control intensity, unblanking, and optionally five programmable speeds. The VGU employs a smoothing technique to generate smoothed curves and circles.

Font Generator Unit (FGU). A ROM-controlled, end-point addressed stroke generator that uses smoothing techniques for character rounding, the standard FGU has 96 ASCII characters, scaling, and 4 basic sizes. Options include 2D scaling, rotation, ROM-controlled 192 character set (both standard and special), RAM-based programmable font, and program-selectable speeds.

Monitor Control Unit (MCU). The 4-channel MCU interfaces the IOC, the function generators, and the display monitors. It selects any subset of four monitors for display and provides unblank signals for those monitor(s). Color selection circuitry is standard.

Off-line Diagnostic Unit (ODU). An option, the ODU is a 5¼" disk drive which attaches to an asynchronous port on the DPU and provides a complete set of DPU and DGU diagnostics which can be run without host computer assistance.



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Because of ongoing product development, Vector General reserves the right to change specifications without prior notice.